

THE TRILOBITE GENUS *EOHARPES* FROM THE ORDOVICIAN OF BRITTANY AND PORTUGAL

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ABSTRACT. Eoharpid trilobites from the Ordovician of Brittany and Portugal are revised. *Eoharpes guichenensis* Henry and Philippot of Llandeilo age from Brittany is redescribed on the basis of new material and *E. macaoensis* sp. nov. of probable Caradoc age from central Portugal is described. The broadly contemporaneous Armorican species *E. guichenensis* and *E. cristatus* Romano from north Portugal enforces the strong faunal link between the Martigné-Ferchaud synclinorium south of Rennes and the Valongo area during the Llandeilo.

HARPID trilobites are an uncommon element of the Ordovician trilobite faunas of Brittany and Portugal and indeed, as pointed out by Whittington (1949), the group never appears to be numerically abundant even though they persisted over a long period of time and are widely distributed. In the Ordovician of Brittany and Portugal the group is represented by the genus *Eoharpes* Raymond and occurs in beds of Llandeilo age, probably reaching up to the Caradoc in Mação, central Portugal. In Brittany, *E. guichenensis* Henry and Philippot has only been recorded from the Martigné-Ferchaud synclinorium at Traveusot-en-Guichen, south of Rennes (text-fig. 1), where it occurs in the upper part of the Traveusot Formation corresponding to the top of the *Placoparia* (*Coplacoparia*) *tournemini* biozone and base of the *P. (C.) borni* biozone. In Portugal *E. cristatus* Romano is known from Valongo (upper part of Valongo Formation) and possibly Bougado at a similar level to that of *E. guichenensis* while at Mação *E. macaoensis* sp. nov. is probably of Caradoc age and occurs in the 'Schistes à *Orthis Berthoisi*' (Delgado 1908, p. 80).

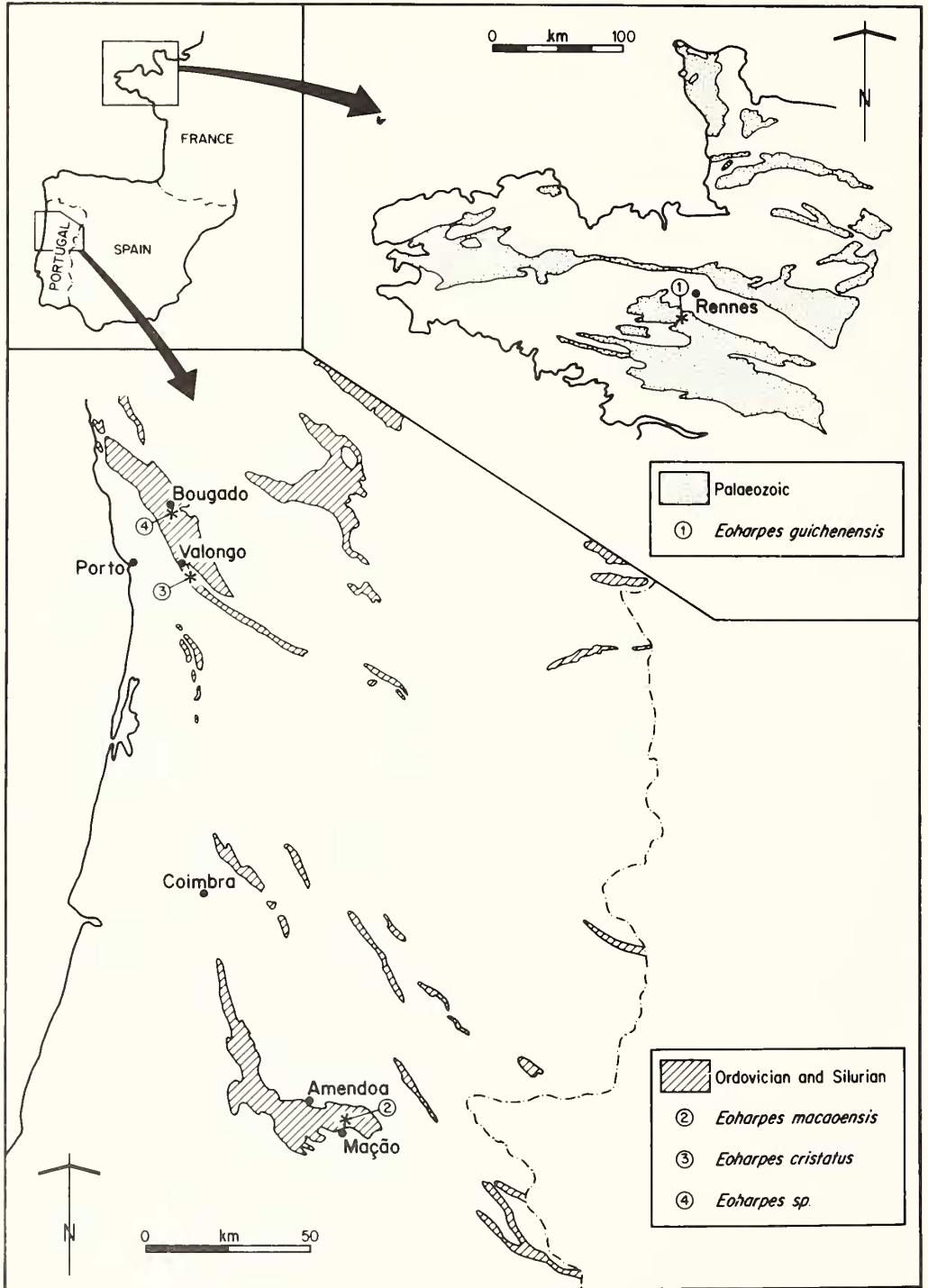
E. guichenensis has previously been described by Chauvel and Henry (1966) and Henry and Philippot (1968) but the discovery of new material has allowed a more detailed description to be given here. The Portuguese material has received only brief attention in the past. Delgado (1908) recorded *Harpes* cf. *primus* Barrande and *Harpes* sp. n. from Bougado and in the faunal lists from the 'Bassin de Tage' (Mação-Amendoa region) he recorded *Harpes* cf. *Doranni* Portlock and *Harpes* cf. *Flanaganni* Portlock. The only recent work on Portuguese harpids was by Romano (1975) who described a new species, *E. cristatus*, from the Valongo area.

The material described and mentioned in this paper is deposited in the collections of the Geological Institute of Rennes University (IGR), Serviços Geológicos of Lisbon (S.G. and M. Romano Collection), and British Museum (Natural History) (BM In).

SYSTEMATIC PALAEOLOGY

General remarks. In the classification of the class *Trilobita* Harrington *et al.* (in Moore 1959) recognized within the suborder Harpina, three families: Harpidae, Harpididae, and Entomaspidae. Some time ago Dr. J. Miller kindly brought to our attention the fact that the name Harpidae had been used previously for a gastropod family. Owen and Bruton (1980, p. 21) have recently reviewed the situation regarding the status of Harpidae following the discussions in the *Bulletin of Zoological Nomenclature* (Beu 1971; Cernohorsky 1972; Rheder 1972, 1973). Until a ruling is made by the Commission on Zoological Nomenclature the name Harpidae is used here.

The terminology adopted is that of Whittington (1949, 1950) with the following addition. 'Alar ridge' is used for the ridge bounding the abaxial part of the ala running from the axial furrow towards the posterior border furrow.



TEXT-FIG. 1. Geographical distribution of *Eoharpes* in Brittany and Portugal showing localities mentioned in the text.

Suborder HARPINA Whittington, 1959
 Family HARPIDAE Hawle and Corda, 1847
 Genus *EOHARPES* Raymond, 1905

Type species. Harpes primus Barrande, 1856.

Diagnosis. After Whittington 1949, 1950, and in Harrington 1959, and incorporating our modifications: cephalon subcircular in outline, convex. Glabella gently convex, highest point at mid-line of occipital ring, anteriorly depressed below the cheek lobes; basal glabellar lobes small. Eye tubercles small, eye ridges may or may not be present. Alae sub-semicircular, flattened, weakly defined, and depressed below level of cheek lobes. Girder extending to tips of prolongations. External and internal surface of glabella and cheek lobe may show ornament. Cheek-roll prolongation broad, almost parallel sides, with bluntly rounded tip. Brim flat, laterally sloping gently downwards, anteriorly raised dorsally in a low fold. Pits of medium size, irregularly spaced. Hypostoma pear-shaped in outline, with broad anterior and posterior borders. Middle body oval in outline, without middle furrow. Thorax with twelve to fifteen segments, width rapidly reduced in the posterior half. Rachis moderately convex. Pleurae of characteristic harpid form, the outer parts bent vertically down. Pygidium small, outline transverse, three segments only clearly indicated.

Eoharpes guichenensis Henry and Philippot 1968

Plate 63, figs. 7-9

1965 *Eoharpes* sp.; Henry, p. 207.

1966 *Eoharpes* sp. indet.; Chauvel and Henry, pp. 64-66, fig. 1.

1968 *Eoharpes guichenensis* now. sp.; Henry and Philippot, pp. 2187-2189, pl. 1, figs. 1-3.

1980 *Eoharpes guichenensis*; Henry, pp. 39-42, text-fig. 9; pl. 2, figs. 1-4.

Diagnosis. A species of *Eoharpes* with the following characteristics: cephalon oval in outline; glabella convex (trans.), elongated, narrow anteriorly, and covered with fine reticulation; only S1 furrows visible. Cheek lobes strongly raised with anastomosing genal caecae very apparent on external mould. Eye ridges very distinct on external mould, running from axial furrows level with anterior quarter of glabella length and directed obliquely backwards; eye tubercles level with mid-length of glabella, at equal distance from axial furrows and internal border of fringe. Lower lamella of fringe inclined downwards, with a maximum of six to seven pits between girder and cephalic margin.

Type and figured material. Holotype: IGR 2, internal mould of incomplete cephalon, figured by Henry and Philippot (1968, pl. 1, figs. 1-3). Paratype: IGR 1, figured by Chauvel and Henry (1966, fig. 1*a, b*). IGR 6 (Pl. 63, fig. 9). IGR 2340 (Pl. 63, figs. 7, 8).

Other material. IGR 3, 5, 7, 2240, 2242, 2464, 2513.

Horizon and locality. Type and other material from upper part of Traveusot Formation, Traveusot en Guichen, Ille-et-Vilaine, Brittany; Llandeilo age.

Description. The discovery, by Dr. J. Chauvel, of a remarkably well-preserved and nearly complete cephalon (IGR 6, internal and external moulds) has allowed the following detailed description.

Cephalon oval in outline. Glabella narrow, rounded, and depressed anteriorly; limited by wide, deep axial furrows and carries short, faint S1 furrows (only ones visible) orientated obliquely towards posterior. L1 lobes more or less rectangular, projecting laterally beyond sides of glabella. Distal parts of occipital furrow are deep, median portion forms shallow transverse depression. On right side of glabella along axial furrows are oval impressions, smooth and poorly defined (? muscle attachment areas). Glabella covered with dense reticulation formed of small anastomosing ridges. Alae semicircular in outline and delimited on outside by two thick branches of the genal caecae (alar ridges), smooth central zone of low relief. Pitted region in front of pre-glabellar furrow is depressed and crescent-shaped in outline. Cheek lobes strongly raised in relation to fringe, with eye tubercle connected to axial furrow by eye ridge. A second ridge runs from tubercle to internal border of fringe where it disappears. Cheek lobes covered with closely spaced and anastomosing radiating ridges (genal caecae)

between which are small cavities with broadly triangular or rectangular shape. Genal caecae arranged in four bundles, symmetrical in pairs; the two anterior bundles essentially formed by numerous ridges radiating from eye and genal ridges, posterior pair originate from alar ridges. At ends of occipital ring genal caecae seem to pass imperceptibly into dense reticulation as seen on glabella. On internal moulds genal ridges appear to cut genal caecae. But on external mould of IGR 6 (Pl. 63, fig. 9) this impression is due to a difference in orientation of genal ridge compared with radiating ridges. Genal caecae much more apparent on external mould than internal mould of same specimen.

Fringe extensively perforated; width exterior to girder remaining constant except near posterior of prolongations. Pits more or less circular and randomly disposed although up to three to four sometimes aligned and clearly coalesced; pits all approximately same size (150–200 μ) except those of outermost arc on upper lamella which are slightly smaller. Between outer arc and margin of cephalon is a narrow external rim. Lower lamella contains a relatively wide, very deep girder which is marked on upper lamella by a small, smooth ridge bounded internally by large pits arranged in a curve parallel to girder. Beyond girder, on cheek roll, pits of smaller dimension appear again; laterally they are less numerous, but become more abundant anteriorly approaching preglabellar furrow. A small cephalon, with a total length of about 2 mm, was discovered in a nodule from Traveusot. Among the features of the meraspis stage of unknown degree are the developed external rim, strongly inflated cheek lobes, and the absence of S1 furrows.

Hypostoma and pygidium unknown.

Discussion. As noted earlier (Chauvel and Henry 1966; Henry and Philippot 1967), *E. guichenensis* is close to *E. primus* (Barrande 1856) and *E. benignensis* (Barrande 1872), Bohemian species which appear in the Šárka Formation (Llanvirn) and Dobrotivá Formation (Llandeilo) respectively. From the fringe pits *E. guichenensis* closely resembles *E. primus*, but is distinguished by the inclined lower lamella, the shape of the L1 lobes and the glabella which is more elongate and narrower anteriorly, the pronounced convexity of the cheeks, the more anteriorly placed eye tubercles, and the eye ridges orientated obliquely towards the genal angles. These distinctive characters are also seen in *E. benignensis*, but the pits on the fringe are here large and more numerous than in *E. guichenensis* (see Whittington 1949). For a comparison with *E. macaoensis* sp. nov. and *E. cristatus* Romano see under the discussion of those species. The assigning of the genus *Eoharpes* to the badly preserved example figured by R. and E. Richter (1954, pl. 1, fig. 5) seems debatable; the eleven thoracic segments is not characteristic of the genus as they appear to vary from twelve to fifteen (Whittington 1949, p. 223).

Eoharpes macaoensis sp. nov.

Plate 63, figs. 1–6

?1908 *Harpes* cf. *Flanaganni* Portlock; Delgado, p. 80.

?1908 *Harpes* cf. *Doranni* Portlock; Delgado, p. 80.

Diagnosis. A species of *Eoharpes* with the following characteristics: glabella nearly parallel sided and covered with fine reticulation. Prominent alar ridges round outside of alae; genal caecae radiate out

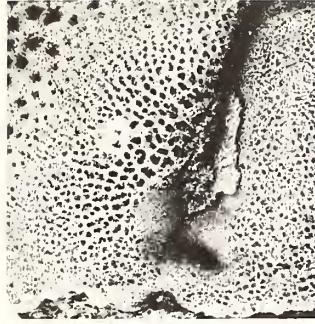
EXPLANATION OF PLATE 63

Figs. 1–6. *Eoharpes macaoensis* sp. nov. All specimens from 500 m N. 52° E. of the village of Pereiro, Mação, central Portugal. 'Schistes à *Orthis Berthoisi*', probably Caradoc. 1, incomplete cephalon, paratype, M. Romano Collection 6, internal mould, dorsal view, $\times 3$. 2, cephalon, paratype, M. Romano Collection 8, latex cast, dorsal view, $\times 3$. 3, 4, incomplete fringe, paratype, M. Romano Collection 7, latex cast, dorsal view, $\times 3$ and approx. $\times 8.5$ respectively. 5, 6, cephalon, holotype, M. Romano Collection 4, latex cast, dorsal view, $6, \times 3$; 5 (detail of 6), showing ornament of glabella and cheeks, $\times 7.5$

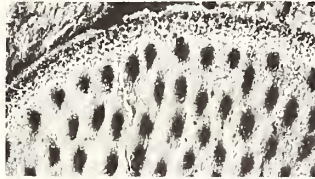
Figs. 7–9. *Eoharpes guichenensis* Henry and Philippot, 1968. All specimens from Traveusot en Guichen, Ille-et-Vilaine, Brittany. Upper part of Traveusot Formation; top of *Placoparia* (*Coplacoparia*) *tournemini* biozone and base of *Placoparia* (*Coplacoparia*) *borni* biozone, Llandeilo. 7, 8, cephalon, IGR 2340, oblique lateral and right lateral view, $\times 6$ approx. 9, detail of cephalon IGR 6, showing ornament of glabella and cheeks, latex cast, dorsal view, $\times 8$



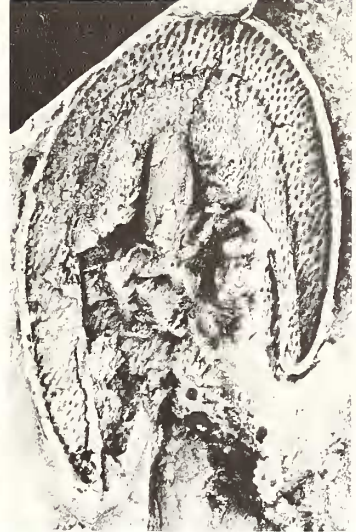
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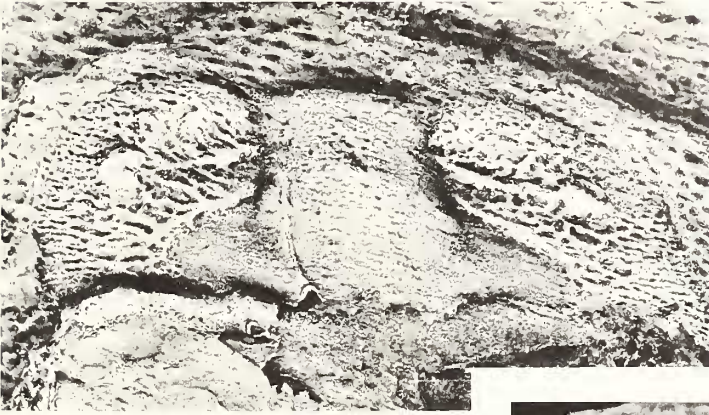
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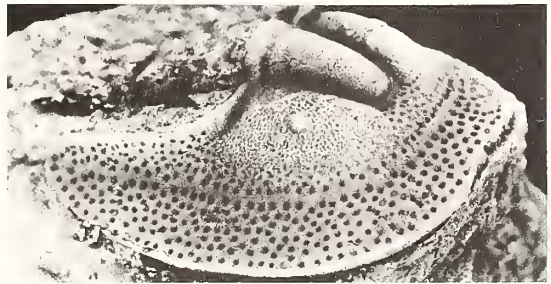
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7



8

from posterolateral corners of glabella, genal ridge absent. Approximately eighty-five pits forming outermost arc on brim where pits are slightly larger and more regular than on rest of fringe. External rim covered with fine, densely spaced tubercles which merge into a delicate reticulate pattern.

Type and figured material. Holotype: M. Romano Collection 4, external mould of nearly complete cephalon (Pl. 63, figs. 5, 6). Paratypes: M. Romano Collection 6, internal mould of incomplete cephalon (Pl. 63, fig. 1). M. Romano Collection 8, external mould of nearly complete cephalon (Pl. 63, fig. 2). M. Romano Collection 7, external mould of lower lamella (Pl. 63, figs. 3, 4).

Other material. M. Romano Collection 9, internal mould of nearly complete cephalon. M. Romano Collection 10, fragment of fringe.

Horizon and locality. All material from 500 m N. 52° E. from the village of Pereiro, Mação, central Portugal. Probably Caradoc age.

Description. Cephalon horseshoe-shaped in outline with posterolateral margins of fringe slightly incurved. Deformed material shows length to width ratios of cephalon which vary from 1:0.7 to 1:1.3. Genal prolongations extend backwards beyond posterior border for just under half the total length of cephalon. Glabella relatively narrow, under half the length of cephalon (excluding prolongation) and under one-fifth the width along posterior margin. Glabella gently convex dorsally lying below highest part of cheek lobes and sloping forwards anteriorly. Sides of glabella converge gently forwards and are evenly rounded anteriorly. Axial furrows well marked laterally but shallow anterior to glabella. S1 furrows do not appear to be present. Occipital ring delimited laterally by deep occipital furrow which fades medianly to very faint transverse depression. Surface of glabella covered with subdued reticulate ornament (visible on external and internal moulds); on holotype the reticulation has crude transverse alignment, probably the result of deformation. Semicircular-alae present adjacent to posterior third of glabella. Alae are smooth, lie below level of surrounding cheek lobe, and are delimited on outside by prominent alar ridge which runs from axial furrow and dies out before posterior border furrow. On the holotype genal caecae just cross alar ridge and come to lie on outer part of alae. Very faint alar furrow occasionally developed but normally alae delimited only by change in slope formed by ridge adjacent to flat surface of alae. Preglabellar field lying between anterior margin of glabella and girder is covered with prominent pits which grade rapidly into typical ornament on cheek lobes; anteriorly this field has uninterrupted connection with fringe pits. Cheek lobes convex, standing above glabella and sloping down steeply to fringe. Highest part occurs just anterior to mid-line (exsag.) which approximately coincides with position of eye tubercle. Eye tubercles relatively large and situated about middle (trans.) of cheek lobes. Prominent (on external mould) eye ridge runs from eye tubercle inwards and slightly forwards to axial furrow where it is best developed. Surface of cheek lobes covered with pattern of radiating and anastomizing ridges (genal caecae); furrows between ridges formed of irregular-shaped pits. Genal caecae clearly visible on external and internal moulds and radiate out from area which, when ridges traced backwards across alae, appear to originate from posterolateral part of glabella. Genal caecae decrease in width and increase in number (from ten to over thirty) from alae towards fringe by irregular branching. Relationship between genal caecae, eye ridge, and alar ridge not clear; genal ridges not definitely identified. Just in front of posterior border, where alar ridge dies out, genal caecae decrease in size and take on the more subdued ornament of glabella. Posterior border furrows deepest adaxially and die out laterally; posterior borders short (exsag.) and convex dorsally.

Fringe consists of wide brim, gently sloping outwards, and narrow cheek roll which declines steeply outwards. Deep, well-marked girder extends to tip of prolongation. More or less circular pits, relatively large and although generally randomly arranged outer and inner arcs of brim are more regular. Maximum of eighty-five pits in outer arc and approximately seventy in inner arc; six to seven pits across width of brim anteriorly. On upper lamella, site of girder marked by faint ridge with even arc of large pits external to it. Wide, convex external rim with marginal suture. Lower and upper rims covered with fine, densely spaced tubercles which merge to give delicate reticulate pattern. To a lesser extent, especially on lower lamella, this ornament continues on to fringe where tubercles encroach on outer slopes of fringe pits.

Thorax imperfectly known. One specimen shows five thoracic segments impressed through from below; they appear to be of typical harpid type.

Hypostoma and pygidium not known.

Discussion. *E. macaoensis* sp. nov. differs from *E. primus* in having a more pronounced pattern of radiating and anastomizing genal caecae, the eye tubercles situated further back, more clearly defined alar ridges, and the ornament of fine tubercles on the rim. *E. benignensis* has a relatively wider

brim with a greater number of pits across the width; also the cheek lobes of the Bohemian species are considerably more inflated. The differences between *E. macaoensis* and *E. guichenensis* are less marked than with the Bohemian species but the absence of the genal ridge, slightly larger and more regular pits in the external arc of the brim, and the ornament on the external rim of the Portuguese species serve to distinguish it from the French species. *E. cristatus* from north Portugal does not possess eye ridges, the pattern of ridges on the cheek lobe is less distinct than in *E. macaoensis* and the ridge on the posterolateral part of the prolongation is absent in the species from Mação.

Eoharpes cristatus Romano 1975

1975 *Eoharpes cristatus* sp. nov.; Romano, pp. 28–32, pl. A, figs. 1–4.

Diagnosis (supplementary to that of Romano 1975, p. 28). A species of *Eoharpes* with the following characteristics: cephalon of horseshoe outline, glabella apparently smooth and with faint S1 furrows. Cheek lobes convex, with anastomizing, radiating genal caecae visible on internal and external moulds. Eye tubercles lie just anterior to mid-length of glabella; eye ridges absent. Approximately eighty-two pits around external arc and six to seven pits across anterior width of brim. Concentric ridge lying on upper lamella internal to outermost arc of pits on posterior part of prolongation of brim.

Type material. Holotype: M. Romano Collection 1, internal and corresponding external mould of nearly complete distorted cephalon.

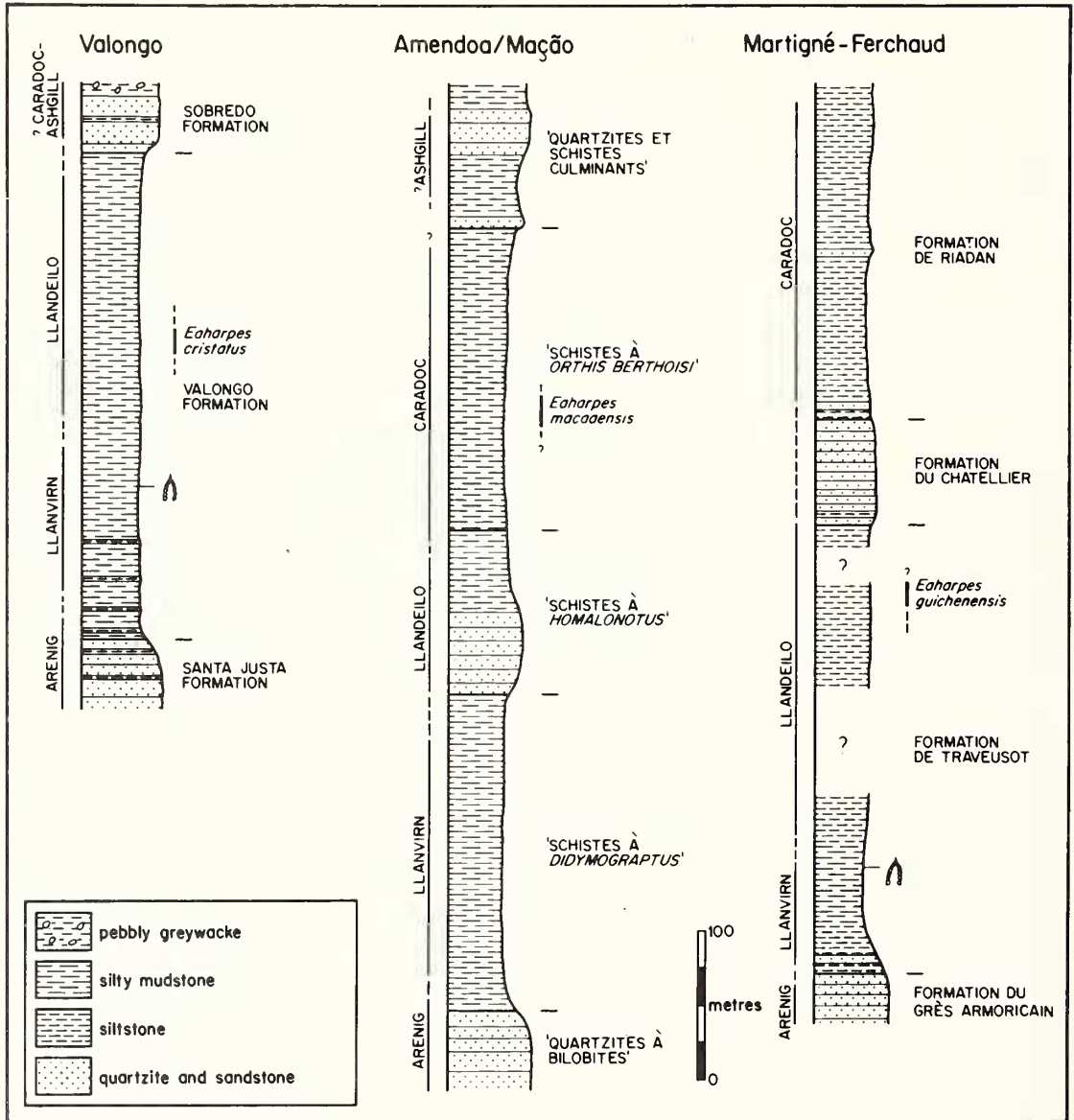
Horizon and locality. Valongo Formation; locality A5/6, approximately 100 m above the horizon with graptolites of the *Didymograptus purchisoni* zone. Llandeilo age. Road section, east of the road, near Beloi, 5.5 km SSE. of Valongo.

Discussion. When *E. cristatus* was first described the comparison with *E. guichenensis* was based on the French material available at that time (Chauvel and Henry 1966; Henry and Philippot 1968). Since then the additional specimen discovered by Dr. J. Chauvel has allowed some further comments to be made. The major features separating the two species are the absence of the eye ridge and genal ridge in *E. cristatus*, the slightly larger pits in the outermost arc of the brim in *E. cristatus*, and the lack of the fine ridge at the posterolateral part of the prolongation in *E. guichenensis*. The difference between the two species mentioned by Romano (1975, p. 31) concerning the apparent absence of genal caecae in the French species is now no longer valid.

VERTICAL RANGE AND LATERAL DISTRIBUTION OF SPECIES OF
EOHARPES IN THE ORDOVICIAN OF BRITTANY AND PORTUGAL

In the Traveusot Formation of the Martigné-Ferchaud synclinorium south of Rennes *E. guichenensis* occurs approximately 190 m above *Didymograptus purchisoni* Zone graptolites although the exact horizon is difficult to determine. It is found with a rich trilobite assemblage corresponding to the top of the biozone of *Placoparia (Coplacoparia) tournemini* and base of the *P. (C.) borni* biozone of Llandeilo age (Henry and Clarkson 1975). The genus has not been recorded elsewhere in Brittany. In Portugal eoharpids have been found at Bougado, Valongo, and Mação. Delgado (1908, pp. 100, 107) recorded a trilobite assemblage including *Harpes* cf. *primus* and *Harpes* sp. n. from 2000 m N. 37° W. of the trigonometrical point of Bougado, which lies approximately 18 km NNE. of Porto (text-fig. 1). The harpids occur within Delgado's 'Schists à *Didymograptus*'. In reinvestigating the Bougado area, Teixeira (1957, p. 451, fig. 1) listed *Harpes* sp. from the 'Xisto argilosos Ordoviciano' which he regarded as Llandeilo in age. More recently Romano (1975, p. 28) noted the discrepancy in dating parts of the Bougado sequence and concluded that 'some doubt must remain as to their [harpids] true age'. The Bougado harpid specimens listed by Delgado have now been traced in the collections of the Serviços Geológicos in Lisbon where the labels state that they were found 2000 m N. 20° W. of Bougado trigonometrical point. From Teixeira's map of the area (op. cit.) it would appear as though

the map reference given in Delgado (1908, p. 100; i.e. 2000 m N. 37° W.) is more likely to be correct since this occurs near the western limit of Teixeira's 'Xisto argilosos' of Llandeilo age; the map reference given on the specimens in the Serviços Geológicos plots out in the 'Grauvaques e xistos gotlandianos'. While there still may be some doubt as to the true locality from which the specimens were collected, the age of the harpids may be resolved. In the collection of the Serviços Geológicos are three slabs yielding placopariid trilobites from the same locality as the harpids. These placopariids



TEXT-FIG. 2. Generalized lithological sections in the Ordovician of Valongo, Amendoa-Mação and the Martigné-Ferchaud synclinorium showing the stratigraphic position of the species of *Eoharpes*. The position of the last Llanvirn *Didymograptus* is also shown.

may definitely be identified as *P. (C.) tournemini* which is of Llandeilo age in Iberia (Hammann 1971; Romano 1975), and the Armorican Massif (Henry and Clarkson 1975), and confirms the Llandeilo age suggested by Teixeira.

The specimen from Bougado identified by Delgado as *Harpes* cf. *primus* (S.G. 1254) is a flattened internal mould of a nearly complete but poorly preserved exoskeleton. The cheek lobes appear to be smooth and there are nine to ten pits across the width of the brim anteriorly. The pits in the outermost arc are slightly smaller than the remaining fringe pits. There are an estimated twelve thoracic segments but the thorax/pygidium junction is difficult to interpret. The smooth cheek lobes and large number of pits across the anterior brim distinguished this species from other Armorican and Iberian species. The probable number of thoracic segments and lack of genal caecae in the Bougado species are features seen in *E. primus* but the Bohemian species has fewer pits across the brim. *E. benignensis* also has nine to ten pits across the anterior width of the brim but differs from the Bougado species in that it has a well-developed ornament on the cheek lobes. Until more material is available the Bougado specimen may not be confidently identified and is provisionally referred to *Eoharpes* sp. The other Bougado specimens identified by Delgado as *Harpes* sp. n. are two internal moulds of flattened, incomplete cranidia (S.G. 1256, 1258). The specimens are too poorly preserved to allow identification.

In the Valongo Formation, on the western limb of the Valongo Anticline (Romano and Diggins 1973–1974) east of Porto, *E. cristatus* occurs about 100 m above graptolites of the *D. purchisoni* Zone and, as in Brittany, it is associated with *P. (C.) tournemini*.

In central Portugal, Mação–Amendoa region, harpids are represented by *E. macaoensis*. The Ordovician stratigraphy of this region has received scant attention since the early work of Delgado who described the stratigraphy of the area and included extensive faunal lists (1908, pp. 80–84). In this region Delgado recognized Llanvirn graptolitic mudstones overlying basal Ordovician quartzites (text-fig. 2) containing the almost ubiquitous *Skolithos* and *Cruziana* ichnofacies. Succeeding the Llanvirn mudstones are the ‘Schistes à *Homalonotus*’, a sequence of sandstones in the lower part overlain by silty mudstones, which Delgado correlated with the ‘Schistes à *Homalonotus Oehlerti*’ of the Buçaco region. This latter unit was included in the Cacemes Formation by Mitchell (1974) who considered it to be of Lower Llandeilo age. More recently, however, Henry, Nion, Paris and Thadeu (1973–1974) and Paris (1979) have shown that the formation ranges up into the basal Caradoc. In the Amendoa–Mação region the ‘Schistes à *Orthis Berthoisi*’ succeed the ‘Schistes à *Homalonotus*’ and as well as yielding *E. macaoensis* also contain *Eccoptychile (Eccoptychile) clavigera* (Beyrich) (Romano 1980), *Selenopeltis buchi* (Barrande), *Primaspis?* sp. (Romano, in prep.), and *Actinopeltis*. Thus the assemblage is almost certainly of Caradoc age but since the overlying ‘Quartzites et Schistes culminants’ are virtually unfossiliferous (Delgado 1908) the upper age limit of the ‘Schistes à *Orthis Berthoisi*’ is not known.

The presence of *Eoharpes* and *Dionide* (Henry and Romano 1978) in Brittany and Portugal contrasts with the situation in Spain where, although otherwise similar faunas and sequences are known from the Luso–Alcudian Zone (Hammann and Henry 1978), as far as the authors are aware neither of these genera have been recorded. The reasons for this are not apparent but are presumably related to migration patterns and/or ecological constraints; although there does not appear to be any strong evidence for the latter.

CONCLUSIONS

The presence of *Eoharpes* from the Martigné-Ferchaud synclinorium in Brittany and in the Bougado and Valongo areas in north Portugal enforces the earlier suggestions of a close faunal resemblance between these areas during the Llandeilo (Henry *et al.* 1973–1974; Hammann and Henry 1978; Henry and Romano 1978) although with the eoharpids the resemblance is only at generic level. The probable younger age range of *E. macaoensis* suggests that in Portugal at least there was a possible southward migration of the group in terms of present-day geography during the Ordovician. This contrasts with an inferred northward migration for other trilobite genera such as *Dionide* and

Selenopeltis in Brittany and Iberia (Henry and Romano 1978; Bruton and Henry 1978) but it is interesting to note that in terms of the model proposed by Paris and Robardet (1977) the apparent migration directions of the trilobite groups in both Iberia and Armorica would be from 'east' to 'west'.

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